How does one establish levels of health for communities? Are measurements of morbidity adequate? These and other significant questions are discussed in a provocative paper. The author suggests that the increased prevalence of various chronic diseases is an indication of better medical care, and proposes that new means be developed to be used in evaluating the efficacy of health care.

MEASURING COMMUNITY HEALTH LEVELS

Barkev S. Sanders, Ph.D., F.A.P.H.A.

THE frequently heard assumption that a high morbidity rate in a community connotes deficient health care would seem plausible. In studying this assumption, however, I have found no evidence to substantiate it, and that is the nub of the matter I would like to consider. As an illustration, I shall use the Kit Carson County[1] morbidity study, one on which I worked with several Public Health Service colleagues.

The three main assumptions of this survey were, first, that the findings would provide a baseline of health. Second, that subsequent provision of more adequate health care designed to fill the studied deficiencies would result in decreased morbidity which measured against the baseline would indicate the gains. Third, whether these gains could be attributed to the new program was to be determined by comparing the rate in the experimental community with morbidity rates of neighboring communities used as controls.

For almost all chronic conditions we found higher prevalence rates in Kit Carson County than in other morbidity surveys. For example, the comparatively higher prevalence rates for all chronic conditions, and for specific chronic diseases for which data were available from the National Health Survey (NHS), were quite definite regardless of whether the comparison was made with the national aggregates or with rural farm areas. This is particularly significant in that the schedule used and other procedures adopted in the Kit Carson County Survey differed little from NHS, and the one main difference militated against obtaining higher rates from Kit Carson County.[2] For a number of important chronic diseases, such as malignancies, allergic disorders, and general arteriosclerosis, the rates obtained from Kit Carson County Survey were two or three times those obtained from the Baltimore or Hunterdon County, N. J., surveys conducted by the Commission on Chronic Illness. Again, the criteria used in these surveys were essentially the same as in the Kit Carson Survey.

Some public health workers were inclined to attribute these high rates to the community's lack of interest in preventive health care. I am not able to validate this interpretation, however, nor does it seem consistent with other criteria of health and health care available for Kit Carson County.[3]

Infant mortality rates which were considered the most sensitive index of community health levels early in this century give Kit Carson County an outstanding health status. The county's rate for the preceding ten years has been about 10 per 1,000 live births. This is far better than existing norms here or abroad. The present national average is about 25 per 1,000 live births and the state with the lowest rate reports about 20. No evidence of incomplete birth or death registration could be discovered in the county at the time of our survey.[4] All deliveries are hospital deliveries.

Kit Carson County had lower age-sex standardized death rates from all diseases than the national average or the average for Colorado. This was also true for heart diseases, despite the fact that the prevalence of heart diseases reported was much higher than that obtained from other surveys. The county prevalence rate for heart diseases was almost twice that obtained by the National Health Survey.[5]

The county's hospital and physician utilization patterns were also more favorable than comparable measures for urban communities of the United States, as obtained by the National Health Survey.[6]

In preventive health services, such as prenatal care for expectant mothers or immunization and vaccination, Kit Carson County ranked above most communities for which similar information was available.[7]

Therefore, as far as the Kit Carson County findings are concerned, the higher prevalence rates for chronic conditions could not be regarded as signifying that this community was more negligent in meeting its health needs than other communities which had reported lower prevalence rates for chronic conditions. If anything, the reverse inference would seem more consistent with the evidence.

Confronted with these findings, it is natural to raise the question whether we have any basis to assume that increased health care would result in lower prevalence of chronic conditions. The absence of any clear-cut evidence for such a relationship, coupled with the fact that we lack medical knowledge to prevent or cure most of the chronic conditions prevalent today, gives us little justification to believe that increased health care could materially reduce the incidence or the prevalence of morbidity. On the basis of theoretical consideration and of available data that have bearing on this, I have come to a diametrically opposite conclusion as far as present conditions in the United States are concerned.

We recognize that most of the numerically important chronic conditions are irreversible. While they cannot be cured, they can be controlled in varying degrees. Nor do we yet know how to prevent most of these conditions.

Improvement in health care would result in earlier diagnosis of chronic conditions and consequent prolongation of the life of these individuals. Both factors would tend to increase the prevalence of diseases and impairments in the population. Moreover, as interest in health increases, some conditions previously overlooked are likely to be considered as morbid. It would seem more reasonable to presume, therefore, that communities with adequate health care would have a higher prevalence of chronic morbidity than communities where health care is inadequate and the sick die earlier.

A number of colleagues have voiced similar views. For instance, in a paper presented at a Joint Meeting of the Biometrics Society and the Statistics Section of this Association 12 years ago, Sartwell and Merrell[8] observed:

"Improvements in therapy may operate either to shorten the course of a disease by bringing about more speedy recovery or, in diseases which may be controlled but not cured, to lengthen the course by prolonging life.

Diabetes mellitus is an example of the latter. Although it cannot be documented, it is highly probable that the prevalence of diabetes is higher today than it was three decades ago, owing to the effect of insulin. Moreover, the trend of recorded crude mortality rates for diabetes, and of age specific rates in the older age groups, has been upward for many years."[9]

The authors touch upon other questions that are germane to our present discussion, but I shall not quote further, although I would commend attention to this article. I wish to elaborate on the key idea of the above quotation—the increased prevalence of a specific disease when medical intervention results in prolongation of life.[10]

I have prepared for this audience a table showing chronic diseases in the order of their rates of prevalence. The table is based on clinical examination findings of a sample of the civilian non-institutional population of Baltimore, who consented to a physical examination offered by the Commission on Chronic Illness. The examination was part of the effort by the commission to establish the prevalence rates of various chronic diseases in the population.

The most prevalent condition listed in the table is obesity.[11] It is only in recent years that public health workers have become concerned with this condition. Obesity as such is not regarded as a disease, but it is associated with a propensity to several diseases. In the abstract, obesity is remediable. In actual practice, however, we have not yet been able to motivate most of the individuals concerned to change their food intake habits sufficiently to remedy this condition. We have a comparable situation with respect to excessive cigarette smoking and other practices inimical to health.

Mental disorders are second in rank. Without getting into any controversy, we can all agree that before the development of the tranquilizing drugs in the mid-fifties we could do very little with psychotic conditions. Even today, with all the tranquilizers and shock therapy, our achievements with respect to mental diseases remain primarily palliative rather than preventive or curative. I say this with no intention of minimizing the value of palliative treatment, or the control of a disease, but merely to emphasize the point that for most chronic diseases increased health care could mean increased prevalence.

Mental diseases, as a rule, are not an immediate cause of death. However, preventive and control measures against diseases causing death have prolonged life, including the lives of psychotic patients. In addition, by making it possible for the population to live longer, we have increased the incidence of these diseases, since their incidence increases sharply with advanced age. Our main point is, however, that there is an increase in the age-specific prevalence rate, independent of aging of the population.

Third in order of prevalence are heart diseases, which in combination with associated vascular and renal diseases account for over two-thirds of all deaths today. Most of these diseases are irreversible, but like diabetes or tuberculosis[12] many of them can be controlled although to a lesser extent. Improved health care is likely, therefore, to result in an earlier diagnosis of the condition. Earlier discovery of the disease coupled with better patient care in many instances would prevent or delay serious incapacitation and prolong life without effecting a cure—again, increasing prevalence.

One could go on down the list in this fashion with respect to most chronic conditions, such as arthritis, hypertension without heart involvement, even neoplasms to a limited extent, anemias of certain types, and so on.

From the nature and chronicity of most of the prevalent diseases as shown in Table 1, and on the basis of our

Table 1—Chronic Diseases by Order of Prevalence per 1,000 Population, Obtained from Clinical Examinations*

Rank	Disease	Rate for 1,000 Population	Per cent of Chronic Conditions	
			Per cent	Cumulative Per cent
(1)	(2)	(3)	(4)	(5)
	All Diagnoses	1,566.5†	100.0	100.0
1	Obesity	128.9	8.2	8.2
2	Mental disorders	108.6	6.9	15.1
3	Heart disease	96.4	6.2	21.3
4	Arthritis	75.2	4.8	26.1
5	Other diseases of female genital organs	66.8‡	4.3	30.4
6	Hypertension without heart involvement	66.4	4.3	34.7
7	Neoplasms	54.9	3.5	38.2
8	Hemorrhoids	53.7	3.4	41.6
9	Other symptoms, senility and ill-defined causes	50.8	3.3	44.9
10	Varicose veins of lower extremity	43.7	2.8	47.7
11	Hay fever, asthma, other allergies	41.5	2.7	50.4
12	Hernia of abdominal cavity	36.6	2.3	52.7
13	Syphilis	36.5	2.3	55.0
14	Orthopedic impairments not elsewhere classified (except cerebral paralysis)	33.8	2.2	57.2
15	Low back strain	30.1	1.9	59.1
16	Diabetes mellitus	26.7	1.7	60.9
17	Anemia	26.0	1.7	62.5
18	Diseases of thyroid	24.6	1.6	64.1
19	Diseases of prostate	22.2‡	1.4	65.5
20	Cervicitis	21.8‡	1.4	66.9
21	Deafness and impaired hearing	20.0	1.3	68.2
22	Cataract (not causing blindness)	17.2	1.1	69.3
23	Diseases of gallbladder	13.7	0.9	70.2
24	Arteriosclerosis	12.9	0.8	71.0
25	Other diseases of circulatory system	12.9	0.8	71.8
26	All other diagnoses	441.1	27.8	100.0

* Source: Commission on Chronic Illness in the United States, Vol. IV, Chronic Illness in a Large City. The Baltimore Study. Cambridge, Mass.: Harvard University Press, 1957; pp. 527-529. Table derived from a sample of the noninstitutionalized civilian population. The list of diseases has been abridged.
† The sum of the rates will not equal this figure due to sex-specific adjustments which have been approximated.
‡ Adjusted to total population by dividing the rate by 2.

available means to cope with them, we believe one is justified to infer that improved health care may result in:

a. Earlier and better diagnosis which will increase the prevalence of recognized diseases (the only type morbidity surveys would show);

b. Increased survival without cure of many diseased individuals, thereby raising the age-specific prevalence rates for many chronic diseases and conditions;

c. Prolongation of life, increasing the proportion of people in older ages with higher susceptibility to chronic and degenerative diseases, thus resulting in higher rates of disease prevalence.

Aside from these factors operating on the living population, there is the possibility that we may be increasing the number of persons with a lower health potential in the newborn population. That is, as a result of more complete

and adequate prenatal, natal, and postnatal care a higher proportion of infants with serious diseases and defects are born and survive to reproduce.[13] Whether there is such an adverse effect on the genetic pool of our population is difficult to assess, but this possibility cannot be overlooked. In general, however, we health workers approach the question of disease prevalence without considering the possible genetic make-up of the surviving populations. I do not wish to overemphasize the importance of genetic factors, as eugenists of the Galton-Pearson School[14] have done, but it would be equally fallacious to ignore them.

What little we know about the subject would lead one to surmise that in a population in which 90 per cent of conceptions result in live-born infants, the health service requirements per infant in infancy and manhood would be greater than in one in which only 50 per cent result in live births to assure the same level of healthfulness if such equalization were attainable. By healthfulness I mean here the common connotation, i.e., a low prevalence of morbidity. In recent decades progressive improvement in health care has resulted in a higher survival of conceptions, and of infants born to survive into productive years of life and to reproduce. Present designs to measure adequacy of health care by the volume of morbidity make no provision for possible genetic differences in the population groups—nor for genetic changes in the virulence of disease, which is another aspect that warrants consideration, though not here.

It would seem uncritical to try to appraise the effectiveness of health care in terms of the extent of morbidity, ignoring completely the possible genetic differences in the health potential of various population groups. As of now, we have no effective way to allow for these differences with any degree of confidence. The least that the health worker can do is to consider simultaneously the death rate with the morbidity rate in the face of indications that in American communities at this time there is probably on the average an inverse relationship between the death rate and prevalence of disease.[15]

Assessment of morbidity in itself presents difficulties of quantification. It would be preferable, therefore, if we could substitute for it a more meaningful and measurable dimension of health. Perhaps the functional adequacy of an individual to fulfill the role which a healthy member of his age and sex is expected to fulfill in his society might be such a substitute. Some such approach as a first approximation seems essential in any attempt to measure the significance of health services, since in human populations we cannot deal with pure genetic strains as we do in animal experiments to assess the therapeutic efficacy of various drugs.

It is proposed, therefore, that we develop a modified life table method of analysis in measuring comparative adequacy of health services for different population groups. In such an analysis we would not only determine for each age the probability of survival, but also the subsidiary probabilities of those surviving on the basis of their functional effectiveness. This would range from individuals who are completely dependent on others, even for carrying on their daily living activities, to those fully equipped to carry on with no apparent handicaps all the functions characteristic of their age and sex.

Ideally, one might begin such a life table with a radix of 100,000 conceptions if and when that becomes practical.[16] In such a table the first numerical value of q would represent the number of conceptions that did not culminate in a live birth. The p would represent the live births. But, instead of being satisfied with p, by sample studies and other information, we would try to

subdivide the p into p_1, p_2, . . . p_n. The subgroups p_1, p_2, . . . p_n would represent the biological adequacy of infants in the best way that we are able to assess it now. In the course of the first year of extrauterine life, if observational data can be obtained, we would want to subdivide our q into q_1, q_2, . . . q_n, according to the respective p's. This procedure could be carried out for each age with such subdivisions along a health gradient as our technical skills permit. Were it possible to construct tables of "effective life years" of this sort, comparative health levels of different communities could be measured in terms of productive man-years resulting from each cohort of conceptions. We could attempt, through such an approach, to follow the entire continuum of life. This method would have an economic connotation, of course, and might be standardized in terms of the number of days on which the average individual was able to engage in productive work as far as his mental and physical capacity was concerned (not necessarily for a paying job).[17]

Therefore, the community which derives a higher number of productive man-years per 100,000 conceptions will be considered to have more adequate health care even though, if our hypothesis is valid, such a community would have a higher age-specific morbidity rate for different chronic diseases and conditions.

While work goes on toward developing data and methods for this sort of analysis, there are intermediate approaches which might be helpful toward a more meaningful comparison of health levels of different communities.

An index of community preventive health services is one example. Such a comparative index could be developed by the examination of appropriate samples of individuals to determine the proportion and the characteristics of those without adequate immunity against disease for which such measures are available. The determination of levels of immunity wherever appropriate should be on the basis of objective laboratory procedures.

Age-sex ratios of known to unknown disease is another type. The quality of health care for different population groups might also be assessed by determining for different age-sex groups the proportion of known pathological conditions to those that are established for the first time by one or more specially arranged clinical examinations. Again, the procedure would be to select appropriate samples from each community and give them one or more physical examinations. To assure comparability, these examinations obviously should be equally thorough and include all other factors essential for uniformity. Under such circumstances the higher the proportion of previously unknown conditions, the less adequate are the health services of the community in comparison to one with a lower ratio.

Disease-specific life table comparison is a third method. Life table technics, including the modified life table analysis which I have proposed, can be used for specific diseases. In such comparisons between different communities the radix would consist of the number of individuals known to have a specific disease. The zero year in such a table would represent the year of discovery of the disease. The life table would in each age-sex specific group show the survival rates of the diseased persons according to their capacity to carry on activities expected of them were they not suffering from the disease. Other things being equal, a community is judged to have more adequate health services when persons of a specified age-sex group diagnosed to have a specific disease yield a greater number of productive man-years.

Early diagnosis is still another measure. With respect to diseases which have well established clinical patterns

and progression—a community where most of the diagnosed cases are in their incipient stage—would have more adequate health services than one where this is less often the case.

There are undoubtedly other useful approaches and technics which can be adopted to appraise, at least crudely, the comparative adequacy of health care received by different communities or population groups. I am inclined to believe, however, that these are relatively partial methods, and that it would be worth our while to see what can be done in developing the procedure of life table analysis as I have suggested. In the Public Health Service we are making some exploratory efforts along these lines, and would welcome help from any quarter.

Summary

In my judgment, measurement of the efficiency of health care should be made in terms of its end product—namely, its contribution to increasing the productive man-years from a given cohort, and not in terms of efforts put forth by health agencies, as is often done when we judge the adequacy of care by such units as the number of nursing visits or the volume of expenditures.

I can appreciate the objection of those who rebel against the idea of measuring efficiency of health care in terms of actual or potential increase in economic productivity—that is, productive man-years. Nevertheless, I believe this approach is justified. Since our resources, i.e., inputs are determined in economic units, it would seem legitimate, indeed appropriate, to use a similar unit to measure the end product. Productive man-years approach this requirement. Productive capacity is an important index of health after childhood and before senium, and in general, is more objectively determinable than morbidity.

This recommended approach also seems to be the desirable one since health is one of the attributes for which we can set no upper boundary. Superficially, one might take the position that whatever can be allotted toward better health care is a gain.[18] However, since community resources are always limited this determination may not be the best. We all recognize that health care is only one of many other requirements essential for good health—proper nutrition, recreation, rest, education, housing, and so on. We, as health workers, therefore, need objective criteria in fixing the optimum amount which a given community should allocate to health care so as to maximize the returns to the community in terms of net increase of what I may call disability-free, productive life. Obviously, this optimum will vary with changes in resources and productive capacity of the community. Thus we must be prepared to assess and reassess this optimum point in terms of measurable tangible criteria.

I appreciate that this goal is in the distant future and even its attainment would be only an approximation of what we would like to measure. Nevertheless, should this not be a worthy aim of public health workers who are interested in assessing the adequacy of community health care? To answer the question of what constitutes adequate health care for a community, we must be able to identify the contribution which that care makes, and the extent to which a reallocation of resources is required to maximize productive man-years per life. This should be the acid test in appraising the efficacy of health services, and in determining whether a community is making optimum outlays for health care. The goal is difficult of attainment, but the stakes are enormous for our nation and for mankind.

REFERENCES

1. Findings of the Kit Carson County Study and their methodological implications for morbidity surveys are presented in A Health Study in Kit Carson County, Colorado (PHS Publ. 844), PHS, U. S.

Department of Health, Education, and Welfare. 1962, 148 pp.

2. In Kit Carson County Survey diagnostic conditions reported were restricted to those current on the day prior to the day of interview. There was no such time restriction in the NHS. For details and for comparisons between Kit Carson findings and the NHS, see reference 1, specifically pp. 59-67.
3. Unreliability of morbidity rates obtained through the survey was demonstrated by wide variation in illness rate reported by different interviewers even when families selected for interview were assigned randomly to different interviewers. See Chap. 2 of publication cited in reference 1. Also Sanders, B. S. Have Morbidity Surveys Been Oversold? A.J.P.H. 52,10:1648–1659 (Oct.), 1962.
4. Greater out-migration might in part account for this unusually low rate, though evidence which we could get did not bear this out.
5. "Heart conditions," defined the same way as in the National Health Survey, the rate for all ages was 52.5 per 1,000 in Kit Carson County as compared with the rate of 28.8 from the NHS. The comparable rate from the Baltimore Health Survey was 21.8.
6. See Kit Carson County Study cited in reference 1, pp. 96-100, 104-109. See also Sanders, B. S. (1) Nature and Extent of Physicians' Services Reported by the Population in Kit Carson County, Colorado. 39 pp. (processed); (2) Some Preliminary Data on Hospitalization in Kit Carson County, Colorado. Derived from Schedule No. 1, 18 pp. (processed); (3) Use of Health Services by the Aged. 10 pp. (processed).
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8. Sartwell, P. E., and Merrell, M. Influence of the Dynamic Character of Chronic Disease on the Interpretation of Morbidity Rates. A.J.P.H. 42,5:579–584 (May), 1952.
9. Ibid. p. 582. Emphasis added. For a confirmation of continuing upward shift of death rates by age from diabetes, see Statist. Bull. Metrop. Life Insur. Co. 43:1–3, 1962. Also special article, Recent Statistics on Diabetes. Diabetes 11:66–9 (Jan.-Feb.), 1962.
10. In World War II this negative association between medical care and prevalence of diseases became evident for pulmonary tuberculosis. Selective Service statistics caused much surprise in indicating a higher rejection rate for whites from tuberculosis in comparison to Negroes. Statistics from death rates had indicated the much higher death rate of Negroes from this disease. For many it seemed anomalous that Selective Service statistics appeared to contradict this well established relationship. Eventually various studies of this seeming anomaly indicated several factors which would account for this. The most important of these was that Negroes contracting tuberculosis succumbed much more rapidly than whites. Thus, despite the much higher incidence the prevalence of tuberculosis among Negroes in these age groups was not as high. See Hearings Before a Subcommittee of the Committee on Labor and Public Welfare, U. S. Senate, 80th Congress, 1st Session, on S.545 and S.1,320, Part 2, Washington 1947, pp. 686-721, especially p. 697.
11. This is an illustration of how conditions, once not considered morbid, may be so regarded with advances in medical knowledge.
12. See reference 10.
13. "There are other serious implications in this area of science. Because of our increased understanding, it has become possible to raise to maturity and breeding age human beings who previously would have died in childhood. Hence we increase in our population the total statistical incidence of these defective genes." (p. 76). National Science Foundation Hearings Before a Subcommitee on Appropriations House of Representatives, 87th Congress, 2nd Session, Highlights of Science in the United States. Testimony of Dr. Philip Handler, 1962, pp. 60-96.
14. Sanders, B. S. Environment and Growth (Part I). Warwick and York, Inc., 1934. 375 pp.
15. It is perhaps suggestive that about 1830 William Farr on the basis of some empirical observations came to the conclusion that in England at that time the proportion of the population sick on an average day was twice the annual mortality. If we could interpret the term sick used by Farr as equivalent to the concept used in the National Health Survey as indicating persons reporting restricted activity we estimate from data given by the NHS for the fiscal year 1960 that there were at least 7,933,000 such persons in our population. Related to the annual deaths this is nearly five times the number of deaths for that fiscal year. It should be remembered, however, that the NHS figures are restricted to civilian noninstitutional population, even though in estimating average prevalence we used the total estimated resident population as of January 1, 1960. But this would not take care of incapacitation by institutional population, and by Americans abroad whose deaths are counted in the denominator. When adjustment is made for these exclusions, the ratio becomes 6 to 1. Intuitively one is led to believe that the increase of persons with known chronic diseases in our population has occurred at an even higher rate than that of persons with days of restricted activity, tending to support our hypothesis of an inverse relationship between health care and morbidity as far as chronic diseases are concerned. Sources: Health Statistics from United States National Health Survey; Disability Days United States, July, 1959-June, 1960, Series B-No. 29; PHS Publ. No. 584. 50 pp. (Table A, p. 3). Deaths obtained from NOVS, and population from Series P-25, No. 262 released by the Bureau of the Census.
16. Recently several studies have appeared giving fetal life tables, one in the J.A.M.A. based on an ethnic group in Hawaii: another based on studies of HIP families; and a third one on samples of mothers in New York City.
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Dr. Sanders is research consultant, Planning and Evaluation Section, Division of Community Health Services, Public Health Service, U. S. Department of Health, Education, and Welfare, Washington, D. C.

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